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MAPLE WILT

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INTRODUCTION

In many sections of the United States the most valued shade and ornamental trees are maples, which in some places make up nearly 90 per cent of the street trees. These trees suffer from the attacks of various twig fungi, leaf-spots, and leaf scorches, which produce a certain amount of foliage loss; but no really serious maple disease was known until 11 years ago, when the maple wilt, which is caused by a fungus belonging to the genus Verticillium, was first reported in this country by W. H. Rankin.

The wilt attracted little attention until the past few years, when the disease showed a very marked increase in many cities and towns in the eastern part of the country. At some places this disease is now causing the death of so many maples that it is considered advisable in future plantings in localities where the wilt is prevalent to substitute other kinds of trees for maples.

PRESENT KNOWN DISTRIBUTION AND HOSTS

The maple wilt has been reported at spots in the region extending from North Carolina and Tennessee to Canada and westward to Wisconsin (Table 1). Further inspection will undoubtedly show that it is more widely distributed, probably being present in a large part of this country. The disease has been found principally upon street trees; but in several different States it has been observed in nurseries, and in three places it has been found in native forest growth of maples near towns or cities. The present known maple

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hosts are silver maple (*Acer dasycarpum*),[1] boxelder (*A. negundo*), Japanese red maple (*A. palmatum rubrum*), Norway maple (*A. platanoides*), sycamore maple (*A. pseudoplatanus*), red maple (*A. rubrum*), and sugar maple (*A. saccharum*). (Table 1.) This circular is based principally upon observations made on Norway and sugar maples and applies primarily to these two hosts, as experience with the other hosts has been limited.

TABLE 1.—*Distribution of maple wilt, by States and hosts*

[Localities where wilt is reported are designated by a plus sign (+)]

Locality	Kinds of maple trees affected						
	Norway	Sugar	Red	Japanese red	Silver	Box-elder	Sycamore
Connecticut	+	+					
District of Columbia	+	+			+	+	
Illinois	+						
Indiana	+						
Kentucky		+					
Maine							
Maryland	+	+	+	+			
Massachusetts		+		+			
Michigan	+						
New Jersey	+	+					
New York	+	+	+				
North Carolina	+						
Pennsylvania	+	+	+				
Tennessee	+	+					
Virginia	+	+	+		+		+
West Virginia	+	+					
Wisconsin	+						

The wilt is most destructive to Norway and sugar maples (figs. 1 and 2) and attacks these two hosts under widely different situations and climatic conditions. The sycamore maple and red maple appear to be very susceptible to the disease in the few cases observed. Silver maples are sometimes attacked and killed, but this species seems to be less susceptible than the others. As the silver maples in many localities are in poor condition on account of scale and decay, it is very difficult to inspect them for wilt. A wilt caused by the same or closely related organisms has been found or reported on a number of woody plants, such as lilac, box, rose, and barberry, as well as on some herbaceous plants, such as potato, eggplant, and tomato.

SYMPTOMS

The most striking symptom of the maple wilt is the dying of one of the limbs of a tree, followed in the same year or in succeeding years by the death of other limbs or of the whole tree (fig. 3). Often the affected parts of the tree die suddenly. One day an entire tree will appear healthy, and the next all the leaves on one of its large branches will be wilted (fig. 1). The leaves soon dry up and appear in conspicuous contrast to the normal green ones. Sometimes these leaves hang on tenaciously, like chestnut leaves on a branch which has been killed by chestnut blight. The dying limbs are most noticeable during August and September. Instead of dying during the growing season, some limbs or parts of trees are killed during the

[1] The nomenclature used accords with that of the American Joint Committee on Horticultural Nomenclature. Standardized Plant Names, 546 pp. Salem, Mass. 1923.

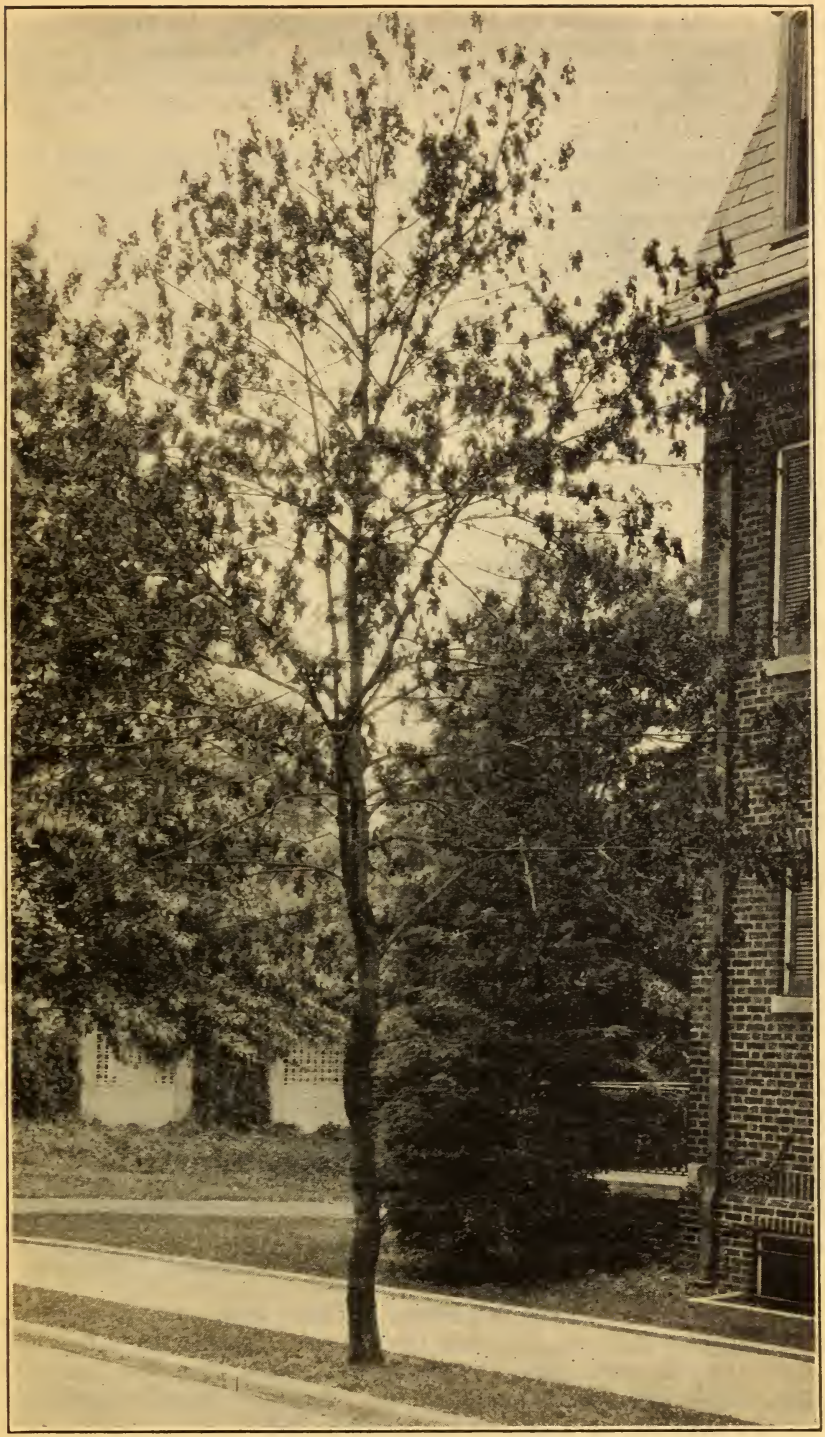

FIG. 1.—Norway maple with yellow drooping leaves. A few days before the photograph was taken this tree was green, and the only symptom of the wilt was the thin foliage

dormant season and do not leaf out in the spring. In some cases the killed limbs are arranged one above another. This effect is produced by the fungus growing up and down in the sapwood of the trunk in a streak, killing one branch above another, rather than by its growing around the trunk.

Sometimes no particular branch dies, but the tree as a whole has a peculiar unhealthy appearance. Often less than one-fourth of the

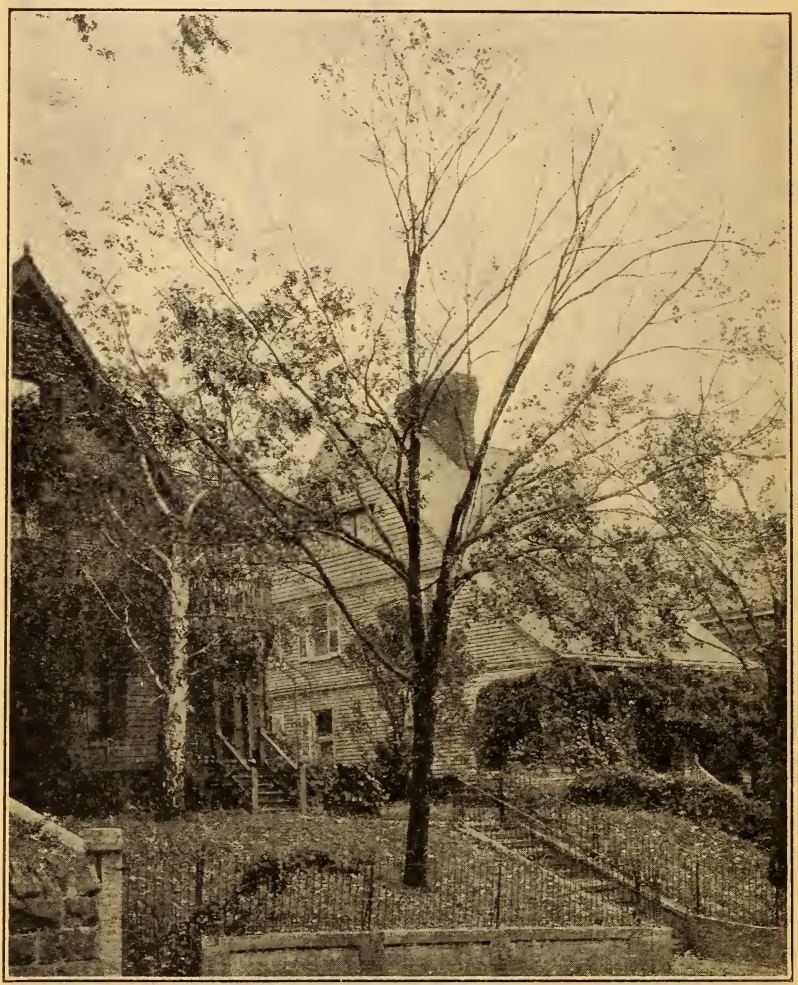

FIG. 2.—Sugar maple gradually dying from maple wilt. The disease was present in the trunk, which was 15 inches in diameter, but was not abundant in the limbs

normal number of leaves is present. Trees with such thin foliage can readily be detected in a row of Norway maples. In a few cases a new growth, resembling water sprouts, was observed along the upper trunk and lower parts of the branches, usually developing after the ends of the branches had been killed.

Another symptom which is present on approximately 10 to 25 per cent of the trees, more particularly on the Norway maple, is the devel-

opment of a slime-flux area on the diseased trunk or branch (fig. 4). This may appear as a typical slimy area or streak, accompanied by a flow of fermenting sap, or it may be simply a small dark soft-bark area, which is usually moist (fig. 5). Often insect borers enter

FIG. 3.—Norway maple killed by wilt. The disease was most prevalent in the trunk at the ground line

such areas, as shown in Figure 6. Subsequently, the bark over these spots or streaks drops off. These bare streaks resemble short lightning scars, and in a number of cases owners of wilt-killed maples thought their trees had been struck by lightning because of their rapid dying and the presence of these streaks. These slime-flux

formations and barkless streaks have been observed in only a few cases on the sugar and red maples and have not yet been noted on the sycamore or silver maple. Sometimes dead streaks which have

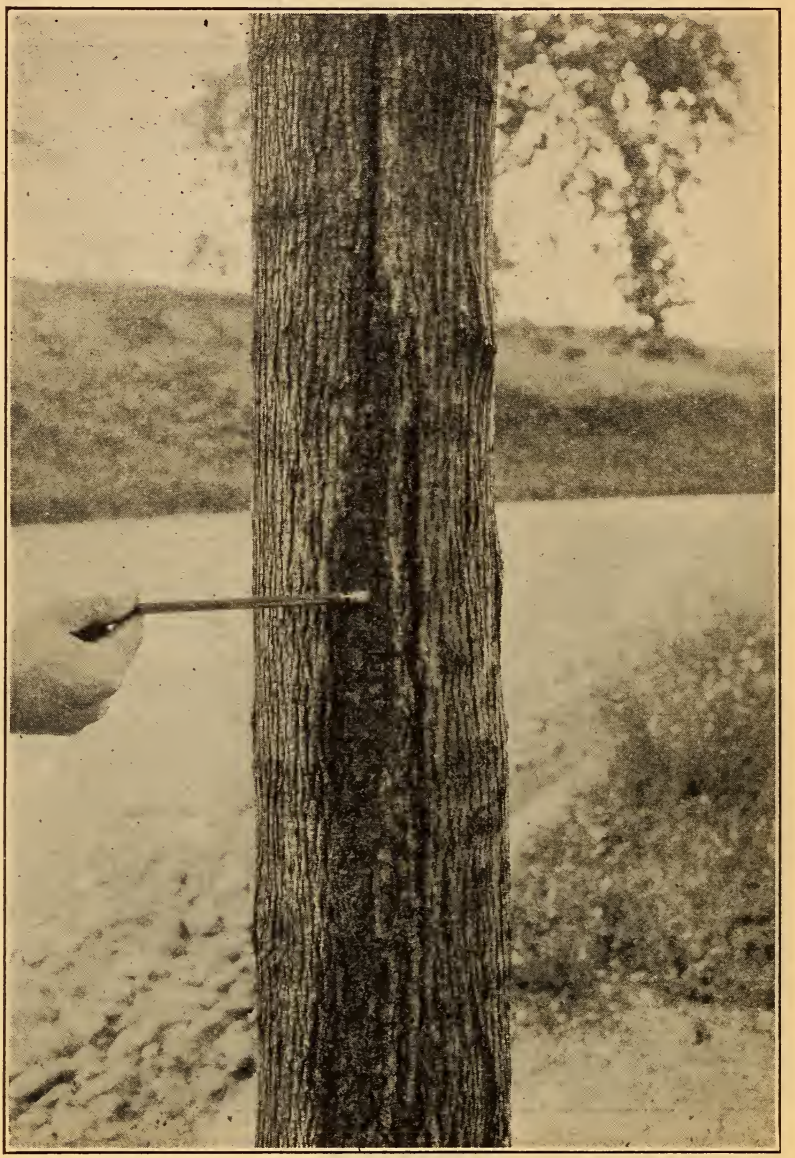

FIG. 4.—Slime flux from a dead streak in the trunk of a maple tree caused by wilt. The bark usually drops from such areas the following year

not been preceded by slime fluxes occur along the trunks of trees infected by wilt. The slime-flux area or dead streak in the trunk indicates the presence of the fungus in the sapwood under it. By fol-

lowing it up the trunk the dead streak will often be found in direct line with the first limb killed by the wilt.

Some trees show only one of the above symptoms and others show several, but all infected trees have green streaks in parts of the infected whitish sapwood (fig. 7). These green streaks in the wood result from the growth of the fungus in the vessels. A cut across the middle or end of an infected limb does not always disclose these streaks, as the fungus often is found principally at the base of the limb or in the trunk. Dissection of a wilted tree will show the greenish streaks running up and down through the wood, often extending from the leaf petioles down the branch and trunk into the roots. Sometimes these green streaks extend into the cambium, but

FIG. 5.—Section of the trunk of a maple tree, showing small dark soft spots, which are often the first indication of the presence of wilt. These appear as five black spots a little to the right of the middle of the trunk. These spots sometimes emit a foul odor, due to fermenting sap. (One-third natural size)

they occur principally in the outer rings of the wood. Though these streaks are the most characteristic symptom of the wilt, it is necessary to guard against mistaking for the wilt the dark-green stain which many maples show around wound or injury. Green streaks which run out into the living sapwood for long distances are almost invariably caused by the wilt fungus. In parts of the trees which have been dead for some time the green areas become darkened, and as the rest of the sapwood of the trunk or limb usually becomes darkened also it is very difficult in many cases to distinguish the wilt areas. It is necessary to study doubtful cases of wilt in the laboratory before a positive diagnosis can be made.

Many maples which die from various other causes display external symptoms resembling those of the wilt. For example, the death

of trees from dirt fillings around the roots, from gas injury, from general unfavorable street conditions, and from insect attack is sometimes mistaken for the wilt. It is difficult in many cases to tell whether the wilt is present without cutting up the tree or making borings in the trunk, as positive determination depends upon finding

FIG. 6.—A dead streak caused by maple wilt. The small circular area with the insect holes in the center of the streak was a soft dark area in the bark during the preceding year

the long green streaks just described. The sudden death of part of a vigorously growing Norway maple usually means, if the possibility of gas injury has been eliminated, that wilt is the cause. However, on slowly growing unhealthy trees the detection of wilt is much more difficult. In many cases the disease is found in trees weakened by other factors. Trees weakened or killed by the wilt are promptly

attacked by various other fungi and insects. Some of the insects which develop in the attacked parts of the tree carry the wilt fungus on their bodies.

MEANS OF ENTRANCE AND SPREAD

By the time one tree has been killed by the wilt there are usually one or more visibly infected trees nearby, sometimes immediately adjoining the dead one, sometimes across the street. Observations in the same localities over a series of years also show the infectious nature of this disease. Not all the means of the spread of the disease from tree to tree and of its entrance into a healthy tree are known. Observations on young infections and inoculations have proved that the wilt fungus can and does gain entrance to the wood

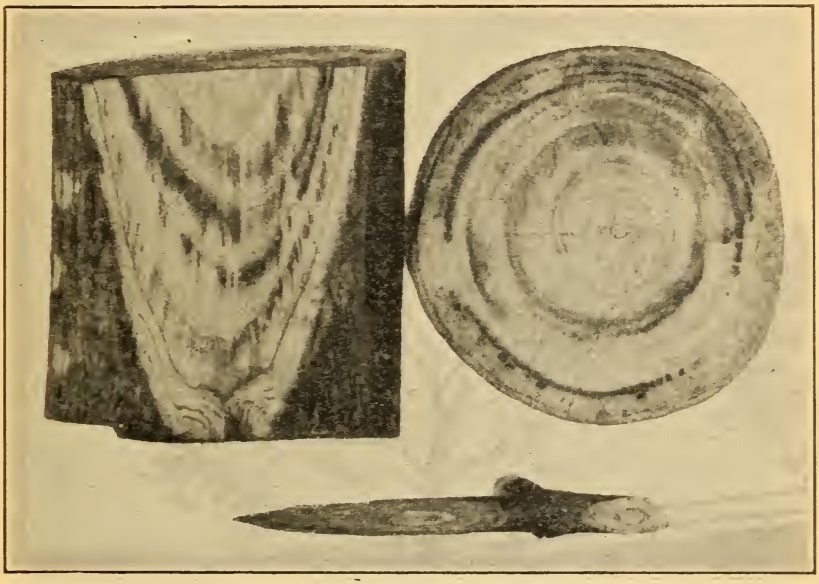

FIG. 7.—Sections of a limb and a twig showing the internal green streaks which are the most characteristic symptoms of maple wilt. These streaks are a much brighter green in living branches than in old dead ones

through wounding. It is thought at present that wounds are the most important entrance points. Those made by man, automobiles, animals, and insects are all important. Cicada stings and injuries made by cattle and horses have been known to afford entrance. Insects and pruning tools furnish two important means of spread from tree to tree, as experiments show that the fungus is carried by both. Infection may be produced artificially through inoculation of roots, as well as through portions of the limbs and trunks, and in two known instances natural infection seemed to have occurred through wounded roots. The wilt fungus probably grows through the soil or roots from tree to tree, though further results from experimental work must be awaited before the importance of this method of spread is determined. It is not yet known how long the wilt fungus remains alive in the soil.

RATE OF SPREAD

The progress of the wilt fungus is not retarded by a vigorous condition of the host (fig. 8); in fact, field observations give the impression that the more vigorous the host the faster the tree is killed. Vigorously growing Norway, sugar, and red maples of large size have been killed within three years after the first limb died (fig. 9). Small trees shipped from a nursery in which wilt was not found have been killed by this disease during the first year after they were planted.

On other trees the wilt has made no further visible progress since the first limb was killed. The trees which form the basis for this statement have been under observation only four or five years, and some of them will probably be ultimately killed by the disease. An-

FIG. 8.—Norway maple with four-fifths of its branches dead from wilt. For the preceding three years this tree made an average twig growth of 12 inches a year. The diameter of the trunk of this tree was 13 inches. This tree was on a farm, far removed from city conditions

other example of the slow progress sometimes made by the wilt is a Norway maple which had the fungus growing in its twigs, branches, and trunk five years ago, but so far not a single limb of it has been killed. This tree has very thin foliage and has made slow growth. However, the disease usually increases steadily until the tree dies in one to six years after the first indication of its presence is noted.

The increase in infection in a particular region or locality is very variable. In some cases a single maple died from the wilt four or five years ago, and there have been no further indications of the presence of the disease in the vicinity. Usually the wilt continues in the locality in spite of control measures, though its spread is decreased by the prompt removal of infected trees or infected parts of them. In other localities some owners have lost most of their maples during the past five or six years.

There are different strains or forms of the wilt fungus, just as there are strains or forms of certain human diseases. These strains vary in virulence on some hosts, and it is expected that studies now under way will show that the difference in virulence of strains is one cause of the erratic behavior of the wilt.

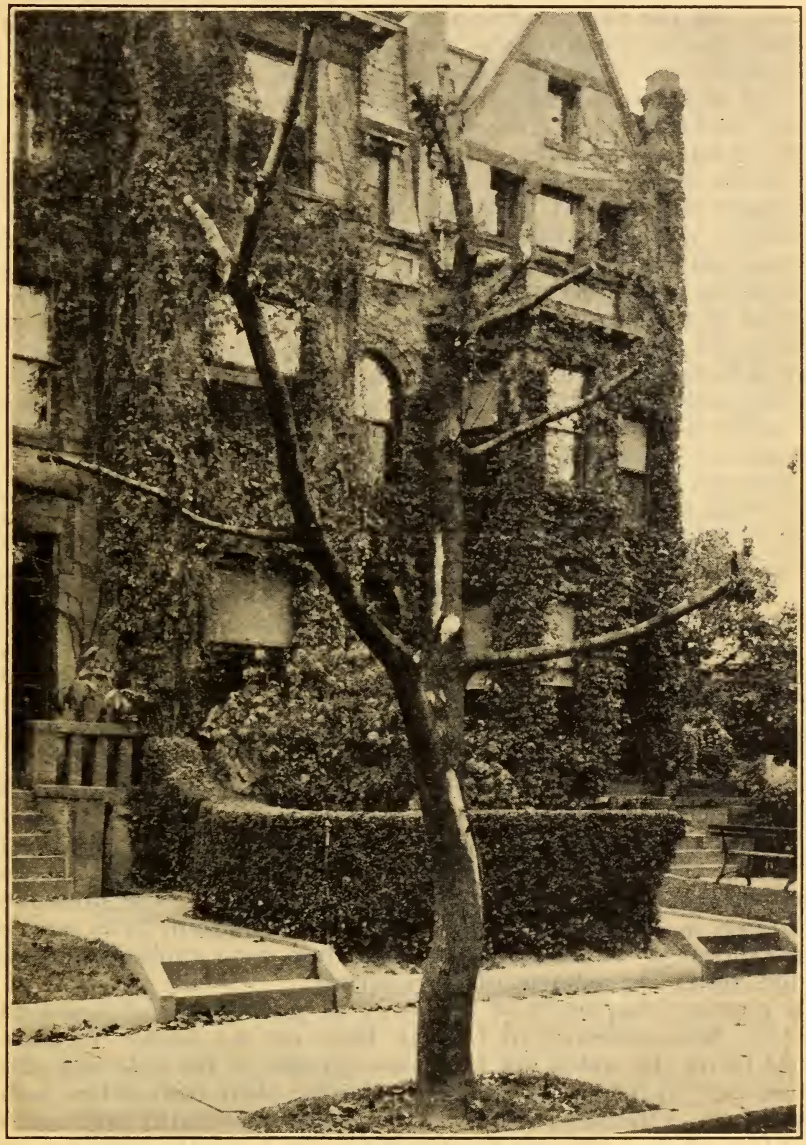

FIG. 9.—Dead Norway maple showing a barkless streak running up its trunk. This tree was completely killed by wilt within two years after the first limb wilted

TREATMENT

Further results from experimental work must be awaited before the practicability of controlling and eradicating the wilt is determined. The sanitation measures here suggested will decrease the

production of wilt spores and lessen the opportunities for the infection of healthy trees, but the eradication of wilt from a locality will probably be a difficult task. The fact that the disease often makes an extensive growth in the wood before showing any external indications of its presence very greatly complicates the possibility of complete eradication, as many of the infected trees can not be found. By the time a limb dies the fungus is usually widely distributed in the wood of the trunk, and it is impracticable, if not impossible, to cut it out. In the rare case in which an infection starting in a limb is detected before it grows into the trunk, the wilt can be eradicated by the removal of the limb.

On an estate where the owner has other valuable maples in addition to the diseased ones, it is considered best to remove immediately and burn the infected trees. Many owners object to this drastic treatment, especially since some of the infected trees may remain in good condition for a number of years after the first limb dies; in fact, there is no certainty that all infected trees will die, though most of them die within a few years after the disease becomes apparent. The fact that the wilt is usually fatal and that it spreads from infected trees to surrounding healthy ones is the basis of the present recommendation for prompt removal. In many cases where the infected trees are large and valuable the owners are advised to remove and burn all dead or dying parts and to paint thoroughly all cuts and wounded surfaces with a mixture of creosote and coal tar. Such trees should be marked and inspected periodically, so that any dying parts may be immediately removed and burned. The application of sanitation measures for the control of the disease in a community where trees are owned by numerous different individuals is often impossible. Many persons not only fail to remove the dead parts of infected trees but even leave dead trees standing, thus giving ideal conditions for the spread of the wilt.

The protection of all wounds is a practice which should be followed in both infected and uninfected localities. Keeping all cuts and wounds covered with an equal-parts mixture of creosote and coal tar will not only prevent the entrance of wood-rotting organisms which cause the loss of many trees but will also keep the wilt fungus from entering through the wood. In order to prevent injury to the living tissue at the edges of the wound, a coating of shellac should be applied before the creosote-tar mixture. The protection of wounds is described in detail in Farmers' Bulletin 1178, entitled "Tree Surgery," which can be obtained free upon application to the United States Department of Agriculture.

In pruning maples it is necessary to guard against spreading the wilt from infected to healthy trees on the tools. Workmen should be on the watch for the green streaks in the cuts and after cutting into an infected part should sterilize their tools before using them again. Mercuric chloride (corrosive sublimate) solution at a dilution of 1 to 1,000 parts of water is used for this purpose, but as it corrodes metals the tools should not be allowed to stand in it. This chemical is poisonous to man and animals, and it should be handled with care.

Maples which have been removed because of wilt should not be immediately replaced by other maples. Such replacement maples

have been observed in a few cases to have been killed by the disease in a short time. Further experiments are necessary before it can be stated how long the wilt fungus can remain viable in the soil. There are many shade trees even more satisfactory than maples, and it would be advisable in many localities to cut down the proportion of maples.

Many tree surgeons and members of street-tree departments and different State departments have assisted in this study by supplying specimens and information concerning infections. It will be appreciated if persons having experience with this disease will extend this cooperation.

SUMMARY

Maple wilt, which was first reported in this country 11 years ago, is now known in spots in the region extending from North Carolina and Tennessee to Canada and westward to Wisconsin. The present known maple hosts are silver maple, boxelder, Japanese red maple, Norway maple, sycamore maple, red maple, and sugar maple.

Some of the symptoms of the disease, such as sudden wilting, thin foliage, slime flux, and dead streaks in the trunk, occur on only part of the wilt-infected maples, but the sapwood of all infected parts contains characteristic green streaks.

The fungus frequently gains entrance to healthy trees through wounds. It can be carried from tree to tree by insects and by pruning tools, though there are various other ways for its spread. The rate of spread of the wilt varies greatly. The suggested treatment consists of sanitary measures, such as cutting out and burning infected parts and the protection of wounds.

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